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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.: —F 15 b 15/00

COMPLETE SPECIFICATION

Hydraulic Device

We, SERCK R & D LIMITED, of Warwick Road, Greet, Birmingham 11, a British Company, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention relates to an hydraulic device of the type comprising a vessel divided into two chambers by a deformable or displaceable wall and has as an object to provide such a device in a convenient form.

A device in accordance with the invention comprises a vessel which is divided into two chambers by an internal wall constituted by a plurality of metal washers at least some of which are dished and at least some of which are resilient, arranged in a stack with the washers in direct engagement with one another, one extreme washer in the stack engaging the vessel and the other extreme washer having an end plate engaging a part of the vessel to pre-stress the washers, the arrangement being such that the introduction of pressurised liquid into one of said chambers will cause the resilient washers to be deformed to increase the volume of said chamber.

Reference will now be made to the accompanying drawings in which: —

Figure 1 is a sectional view illustrating the application of the invention to an electro-hydraulic actuator,

Figure 2 is a sectional view of an hydraulic accumulator incorporating an example of the invention,

Figure 3 is a sectional view showing an example of the invention as applied to an hydraulic ram,

Figure 4 is a sectional view showing a valve for maintaining a constant flow rate therethrough to which an example of the invention is applied; and

Figure 5 is a fragmentary section illustrating a modified form of the invention.

The electro-hydraulic actuator shown in Figure 1 includes an electrically driven pumping device 10 at one end of a cylindrical vessel 11. The interior of the vessel is divided into two chambers by a dividing wall into which the outlet 12 and inlet 13 of the pumping device open respectively.

This wall is constituted by a stack of dished resilient washers 14 arranged so that the concave sides of the washers 14 are alternately directed in opposite directions. One extreme washer 14*a* in the stack abuts against the pumping device 10 whilst the other extreme washer 14*b* has its central hole closed by an end plate 15.

The washers 14 and end plate 15 thus form, in combination, a very inexpensive resilient bellows and for most applications it has been found that the metal-to-metal contact between the washers forms a sufficiently good seal to prevent pressurised liquid outside the bellows from entering it or to enable low pressure liquid to be stored within the bellows. As shown the end plate 15 is urged against the end wall of the vessel 11 so that the washers 14 are pre-stressed to prevent leakage between washers 14 in the initial stages of supplying pressurised liquid to the vessel.

As shown in Figure 2 the invention may also be applied to a simple hydraulic accumulator without the pumping device.

The accumulator consists of a vessel 20 in the form of a cup closed off by a plate 21. A stack of dished resilient washers 22 engage the closed end of the cup and are made into a sealed bellows by an end plate 23. As

[*Price* 4*s.* 6*d.*]

before the washers 22 are pre-stressed. A connection 24 in the plate 21 is used to introduce high pressure liquid into the device for storage. Where the accumulator is to be used for sub-atmospheric pressure liquid (i.e., a liquid under suction) a connection 25 in the closed end of the cup and opening into the interior of the bellows is used.

In the example shown in Figure 3 the ram consists of a vessel 30 the internal surface of which can be considerably less smooth than the internal surface of a conventional ram with a slidable piston. Instead of a piston a stack of dished resilient washers 31 and an end plate 32 are employed. The end plate 32 has three or more projections 32*a* lightly engaging the internal surface of the vessels to guide it for axial motion. A piston rod 33 is connected to the end plate 32 and projects from the vessel through an opening in an annular end closure 34 mounted in the mouth of the vessel. A sealing ring 35 in this opening engages the piston rod 33. The end closure 34 is held in place by a retaining ring 36 sprung into a groove in the wall of the vessel 30 and is urged against the ring 36 by the washers 31 which are suitably pre-stressed.

Pressured fluid can be introduced into the ram through a port 37 in the end of the vessel 30. If there is no external resistance to motion of the piston rod 33 then this will be displaced by pressured fluid by a distance directly proportional to the difference between the pressure applied and a constant term arising from the pre-stressing of the washers 31. Thus the ram can be utilized as an inexpensive actuator in a linear positioning system.

Alternatively the ram can be operated by connecting a port 38, which opens *via* passages 39 in the end closure 34 into the interior of the bellows formed by the washers 31, to a circuit for reducing the pressure within the bellows to a sub-atmospheric level. Once again the device has a linear characteristic.

The invention can also be applied to a wide variety of float and pressure regulating devices. One such device is illustrated in Figure 4 and includes a high pressure port 40 which communicates *via* a passage 41 with the space within a vessel 42 but outside a bellows formed, as before, from dished resilient washers 43 and an end plate 44. The port 40 also communicates with the interior of the bellow through an orifice 45 provided with a variable restrictor 46. The end plate 44 carries a control element 47 which co-acts with a sleeve 48 through which fluid can flow from the device to a low pressure port 49. It will be seen that when fluid flows from port 40 to port 49 the restricted orifice 45 will cause the pressure within the bellows to fall below the pressure outside the bellows. Thus, when the pressure difference is sufficient to overcome the pre-stressing of the washers, the control element 47 will be progressively displaced into the sleeve 48 as the pressure drop rises. The control element 47 has a groove 47*a* of suitable shape formed in it so that liquid can flow into the sleeve 48, but, as the pressure drop mentioned rises such flow is progressively restricted.

If the port 49 is kept at atmospheric pressure then variations in the pressure at port 40 will result in similar rises and falls in the pressure within the bellows. This means that the pressure drop will remain within fairly close limits, so that flow through the device will be substantially constant for all values of the inlet pressure above a minimum value. Such a device can be used for stabilizing the speed of a fixed displacement motor fed from a source of constant pressure but subjected to a variable load.

If desired, adjustable screw-threaded stops 50 may be provided for varying the pre-stressing of the washers 43.

In the modification shown in Figure 5, the bellows is made up of alternate flat washers 70 and dished washers 71. All the dished washers 71 are directed towards one end of the bellows. Either the dished washers 71 or the flat washer 70 may be rigid if desired, provided that the other set consists of resilient washers.

WHAT WE CLAIM IS:—

1. An hydraulic device comprising a vessel which is divided into two chambers by an internal wall constituted by a plurality of metal washers at least some of which are dished and at least some of which are resilient, arranged in a stack with the washers in direct engagement with one another, one extreme washer in the stack engaging the vessel and the other extreme washer having an end plate engaging part of the vessel to pre-stress the washers the arrangement being such that the introduction of pressurised liquid into one of said chambers will cause the resilient washers to be deformed to increase the volume of said chamber.

2. An hydraulic device as claimed in claim 1 in which all the washers are of dished resilient form, and the washers are alternately oppositely orientated in the stack.

3. An hydraulic device as claimed in any preceding claim in the form of a pressure accumulator in which one end of the vessel is formed by a pumping device against which said one extreme washer of the stack engages.

4. An hydraulic device as claimed in claim 3 in which said one extreme washer engages said pumping device on a circle and the pumping device has an inlet opening into the interior of the stack of washers and an outlet opening into the space surrounding said stack.

5. An hydraulic device as claimed in any one of claims 1 to 3 inclusive including a

piston rod connected to said end plate and projecting through an opening in the wall of the vessel.

6. An hydraulic device as claimed in claim 5 in which the end plate is provided on its periphery with at least three projections engageable with the interior of the vessel to guide the end plate as it travels in use, along the vessel.

7. An hydraulic device as claimed in either claim 1 or claim 2 in the form of a flow regulating valve in which a control element carried by said end plate co-acts with a fixed part to restrict flow through one of said chambers in accordance with the difference in pressures inside and outside the stack of washers.

9. An hydraulic device substantially as hereinbefore described with reference to and as shown in Figure 2 of the accompanying drawings.

10. An hydraulic device substantially as hereinbefore described with reference to and as shown in Figure 3 of the accompanying drawings.

11. An hydraulic device substantially as hereinbefore described with reference to and as shown in Figure 4 of the accompanying drawings.

12. An hydraulic device as claimed in any one of claims 9 to 11 inclusive modified as shown in Figure 5 of the accompanying drawings.

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Chartered Patent Agents,
Agents for the Applicant(s).

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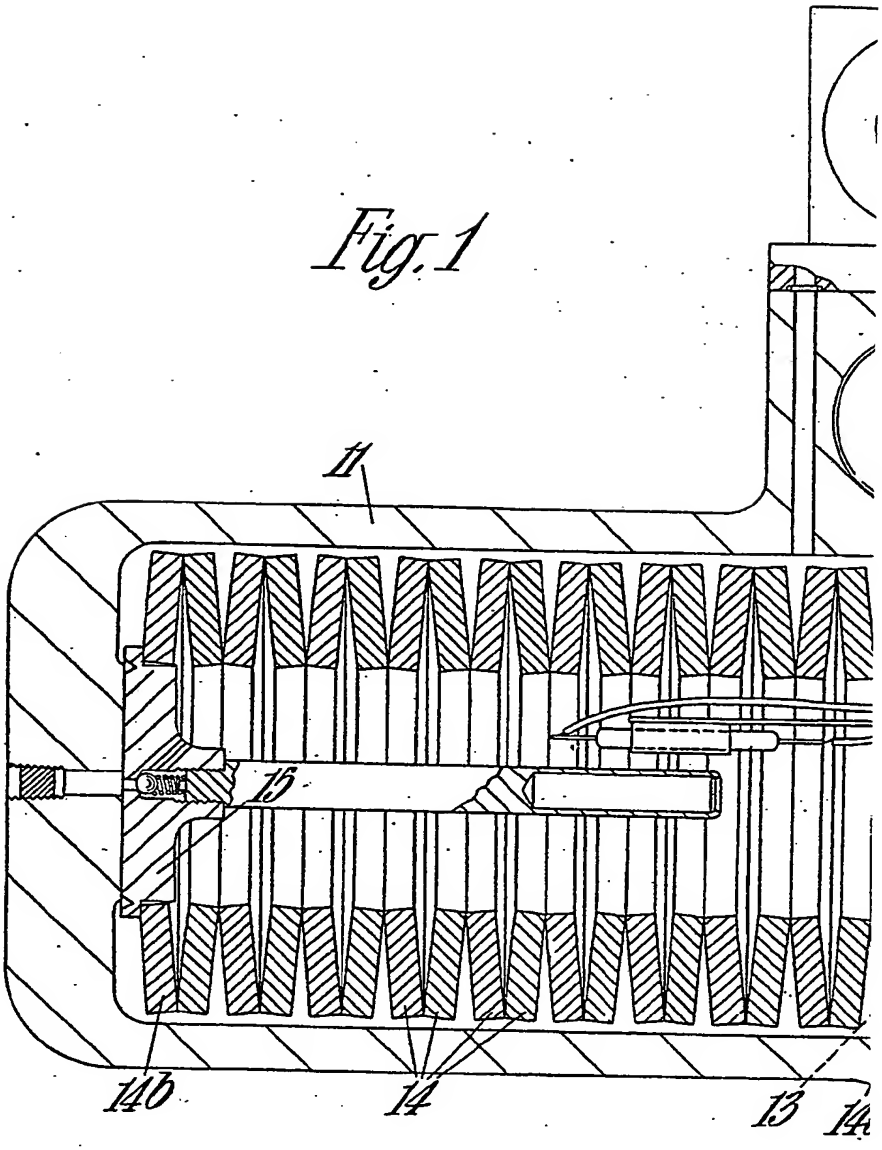
Fig. 1



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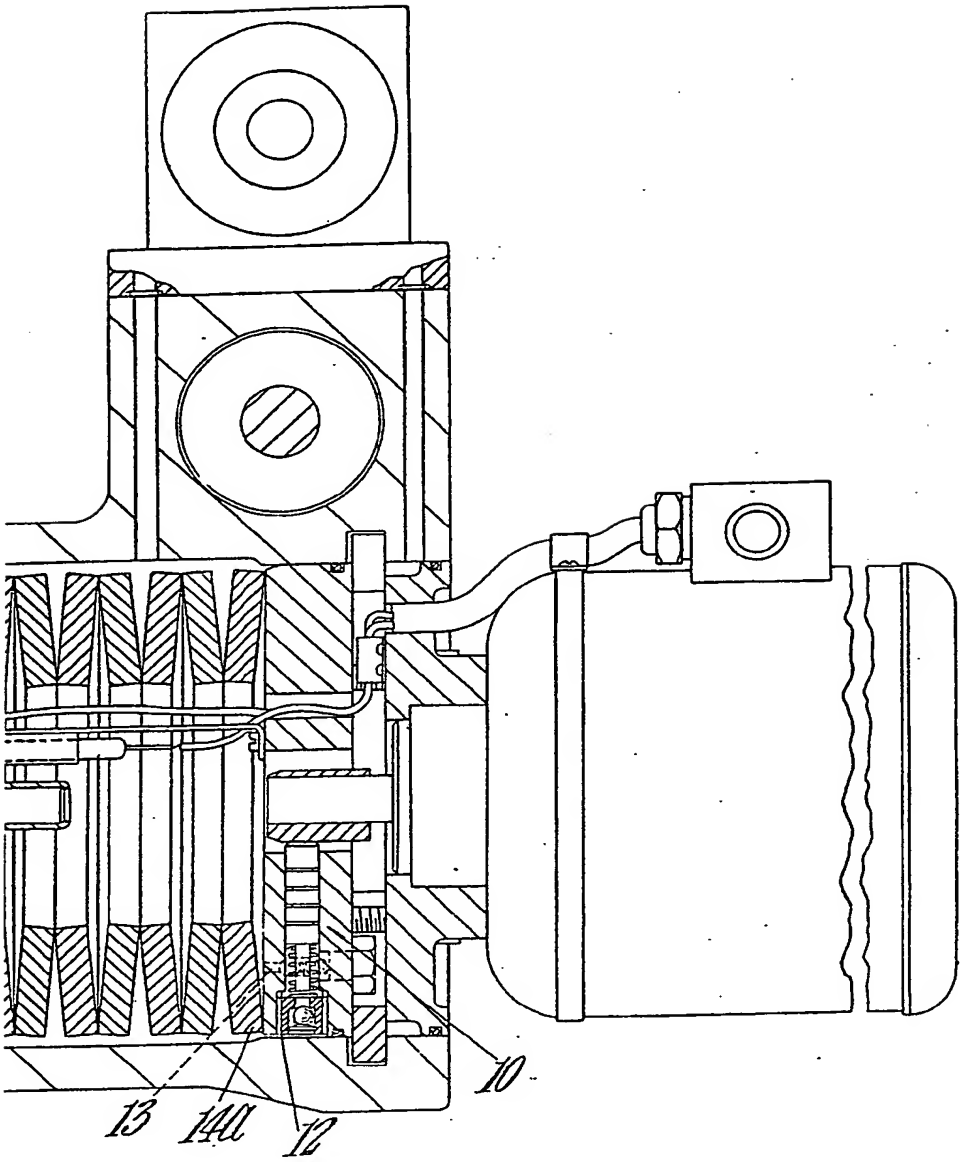

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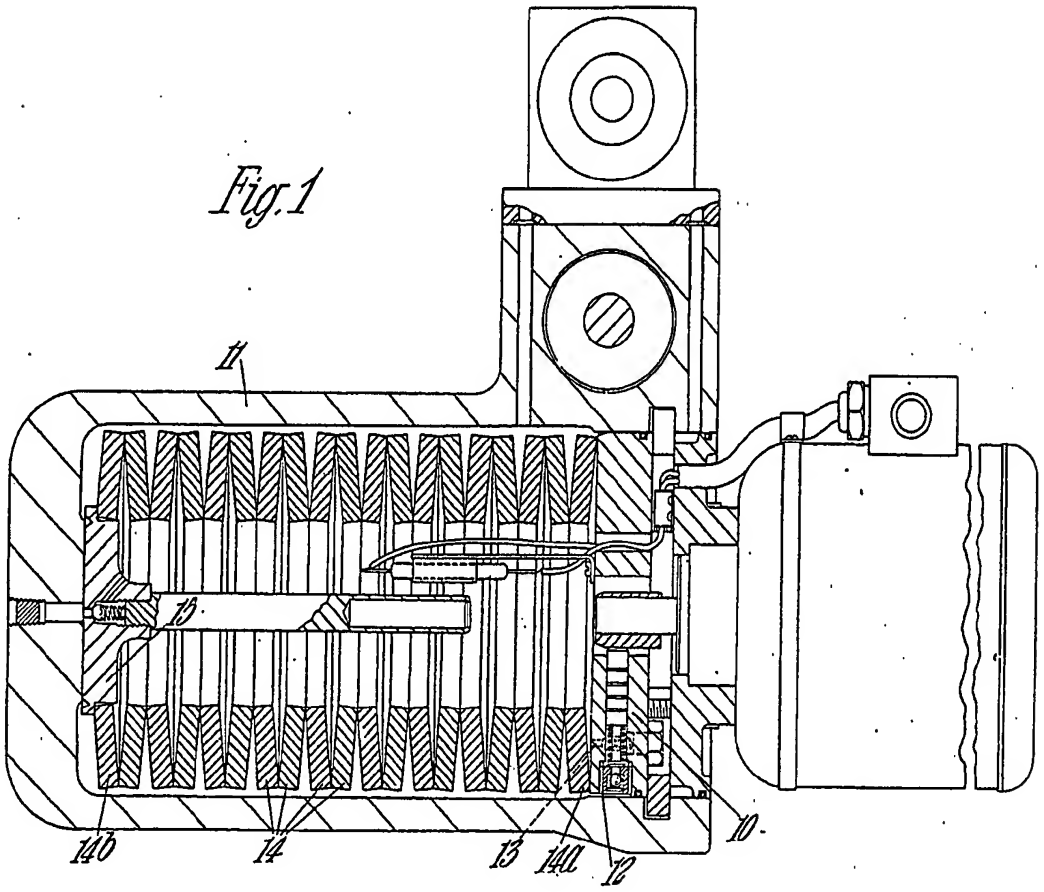
Fig. 1



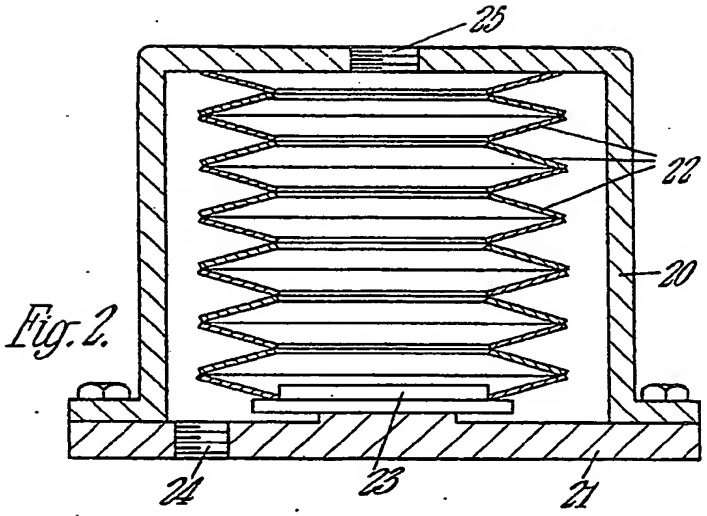
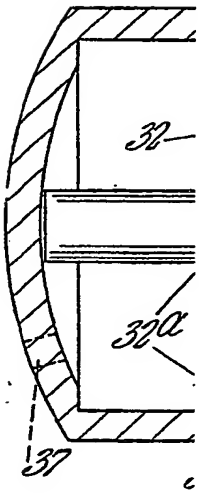


Fig. 2.



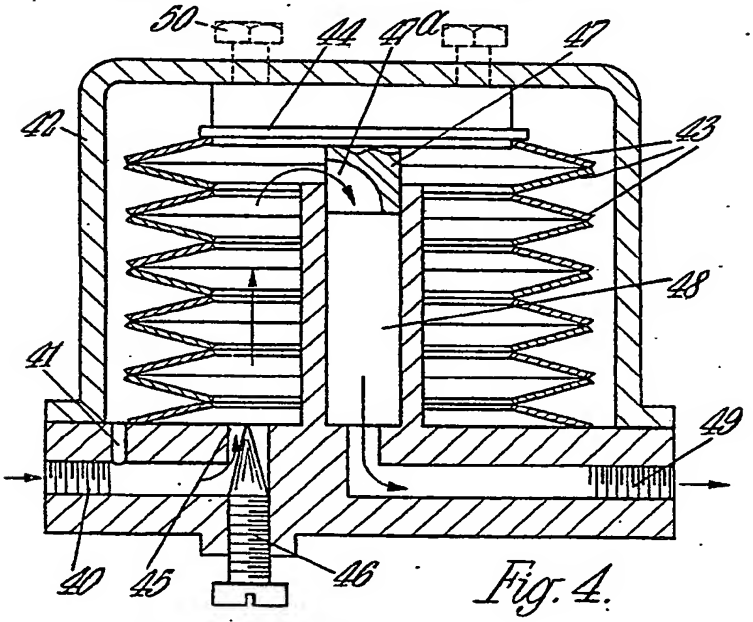


Fig. 4.

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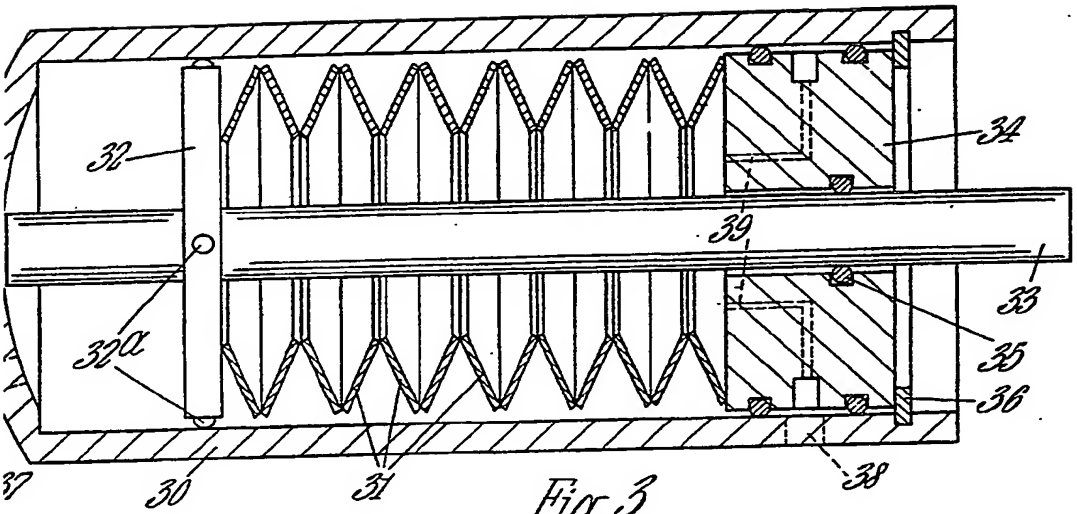

Fig. 3.

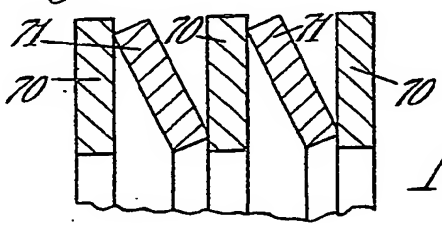

Fig. 5.

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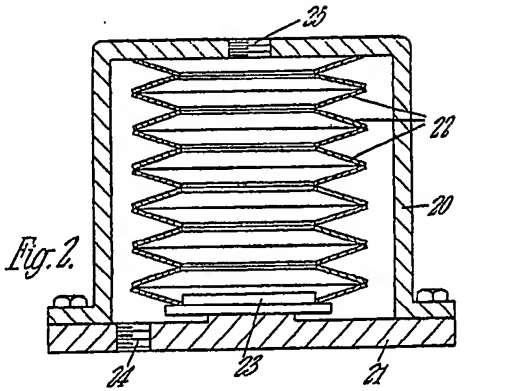

Fig. 2.

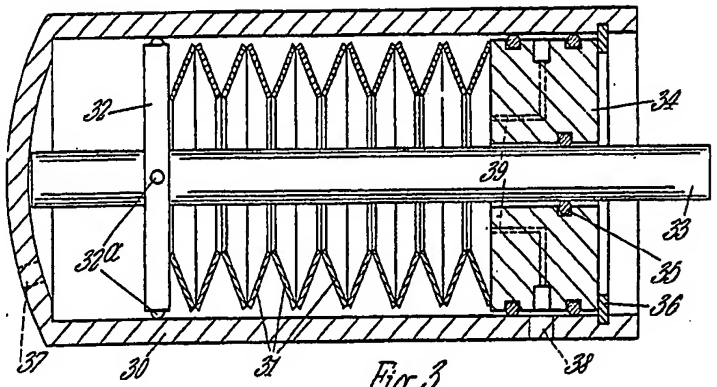

Fig. 3.

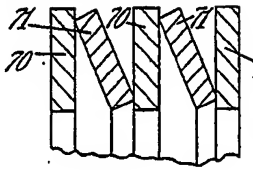

Fig. 5.

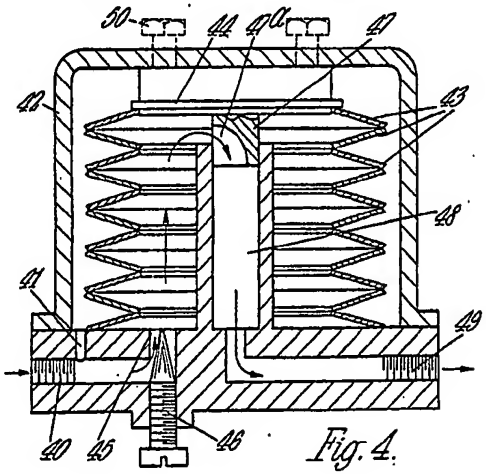

Fig. 4.